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Chapter I-2
Coastal Diversity

I-2-1. Introduction

The coasts, or shores, of the world are the margins separating the 29 per cent of the earth that is land from the 71 percent that is water. By reworking and often eroding the margins of the land, the seas aid streams, subsurface water, glaciers, and the wind in wearing down the continents. Sediments derived from the land are often transient along the coasts, temporarily forming beaches, bars or islands before coming to rest on the sea floor. There is significant natural diversity in shore types throughout the United States and even greater diversity throughout the world (see Part IV for details). Consequently, engineering, development, and policy strategies need to be tailored for each unique region and need to be flexible to changes in the local condition. Coastal engineers, managers, and planners need to be aware of coastal diversity for a number of reasons:

a. The coast is dynamic and constantly evolving to a new condition.

b. The balance and interaction of processes are different in different areas - understanding diversity provides clues to the critical factors that may affect a particular study site.

c. Different settings imply different erosion and accretion sediment patterns.

d. Analytical tools and procedures may be suitable for a particular setting but totally inappropriate for another.

e. Similarly, engineering solutions may only be appropriate for certain settings where they will function properly.

Shorelines are subject to a broad range of processes, geology, morphology, and land usages. Although winds, waves, water levels, tides, and currents affect all coasts, they vary in intensity and relative significance from one location to another. Variations in sediment supply and geological setting add to this coastal diversity. A more detailed discussion and analysis of the processes at work along the United States coasts is given by Francis P. Shepard and Harold R. Wanless in their book *Our Changing Coastline* (1971).

I-2-2. Coastal Areas

The popular image of a long, straight, sandy beach with a sandy backshore and foreshore, vegetated sand dunes, and gently sloping near shore zone with rhythmic plunging breakers may be the ideal image of the zone where the land meets the sea, but is not the norm along most coasts. Not all coastal areas are sandy, nor are all shores dominated by wave action. Some coastal areas have scenic clay bluffs or rocky headlands. Others are shallow mud flats or lush wetlands. For some shores, tidal currents or river discharge dominate sediment transport and the shore character. For other shores, the effects of glaciers, marine life (coral), or volcanoes may control the geomorphology. Shore materials include transportable muds, silts, sands, shells, gravels, and cobbles, and insitu rock formations or bedrock (erosive and non-erosive). In portions of the United States, the coastal area is sinking and gradually becoming permanently inundated; in other areas, new lands are accreting or even rising out of the sea.

a. Atlantic North: Glaciated coast (Figures I-2-1, I-2-2). These coasts are normally deeply indented and bordered by numerous rocky islands. The embayments usually have straight sides and deep water as a

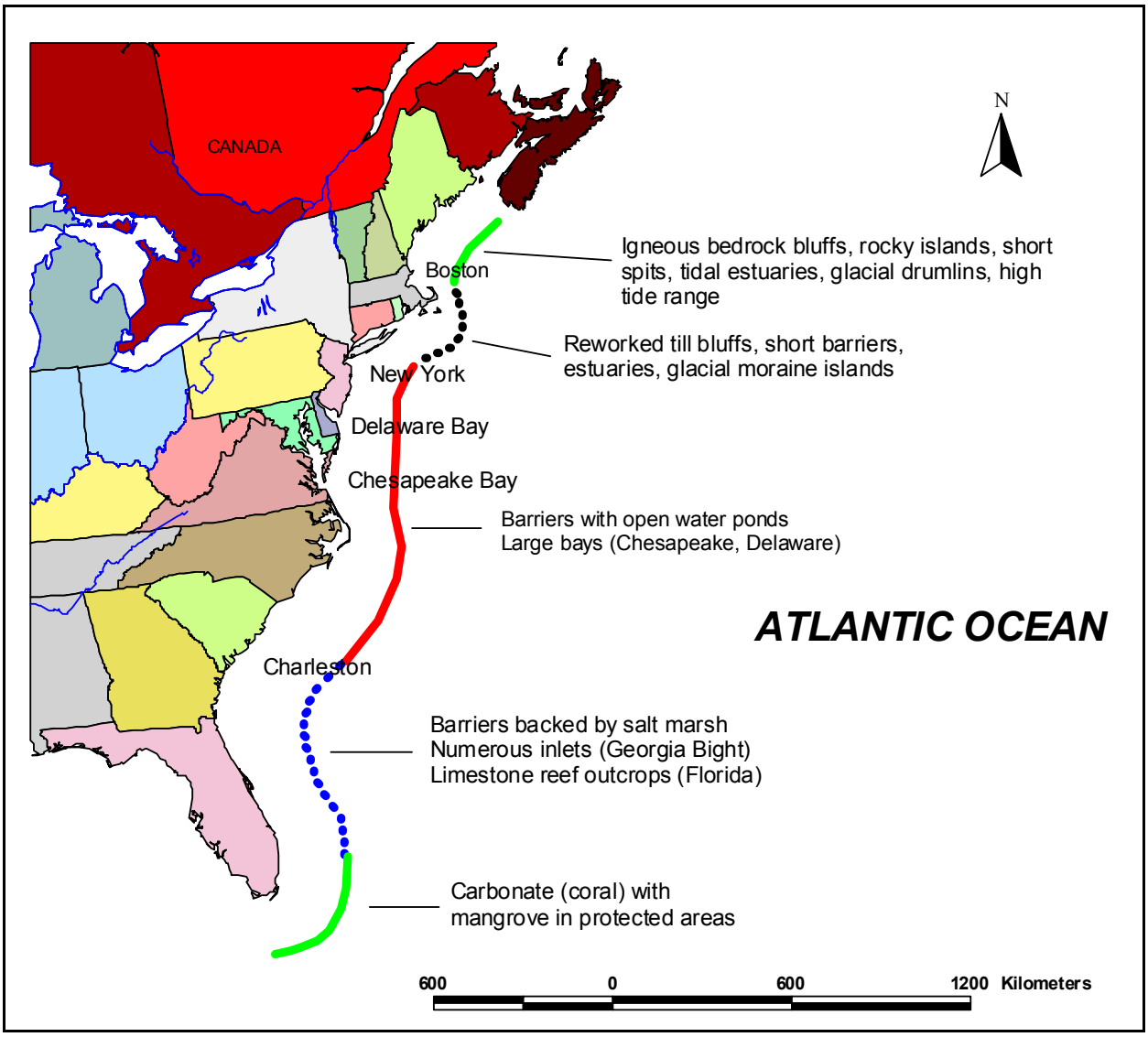

Figure I-2-1. Atlantic coast characteristics

result of erosion by the glaciers. Uplifted terraces may be common along these coasts that were formerly weighted down by ice. Abrupt changes in coastal character occur where glacial deposits and particularly glacial outwash play a dominant role, while in some rocky areas, few glacial erosion forms can be found. Moraines, drumlins, and sand dunes, the result of reworking outwash deposits, are common features. Glaciated coasts in North America extend from the New York City area north to the Canadian Arctic (Figures I-2-3, I-2-4, IV-2-8, and IV-2-9), on the west coast, from Seattle, Washington, north to the Aleutian Islands, and in the Great Lakes. (Figure IV-2-20) (Shepard 1982).

b. Atlantic Central and South: Barrier and drowned valley coasts. South of the glacial areas begins the coastal Atlantic plain, featuring almost continuous barriers interrupted by inlets and by large embayments with dendritic drowned river valleys, the largest being Delaware and Chesapeake Bays. The North American coastline is reported to include over 10,000 km of barriers, about 33 percent of all barrier coast of the world (Berryhill, Dixon, and Holmes 1969). The United States alone has a total length of 4,900 km of barriers and spits, the longest extent for a single nation (Figure I-2-5 and Table IV-2-3). Extensive wetlands and marshes

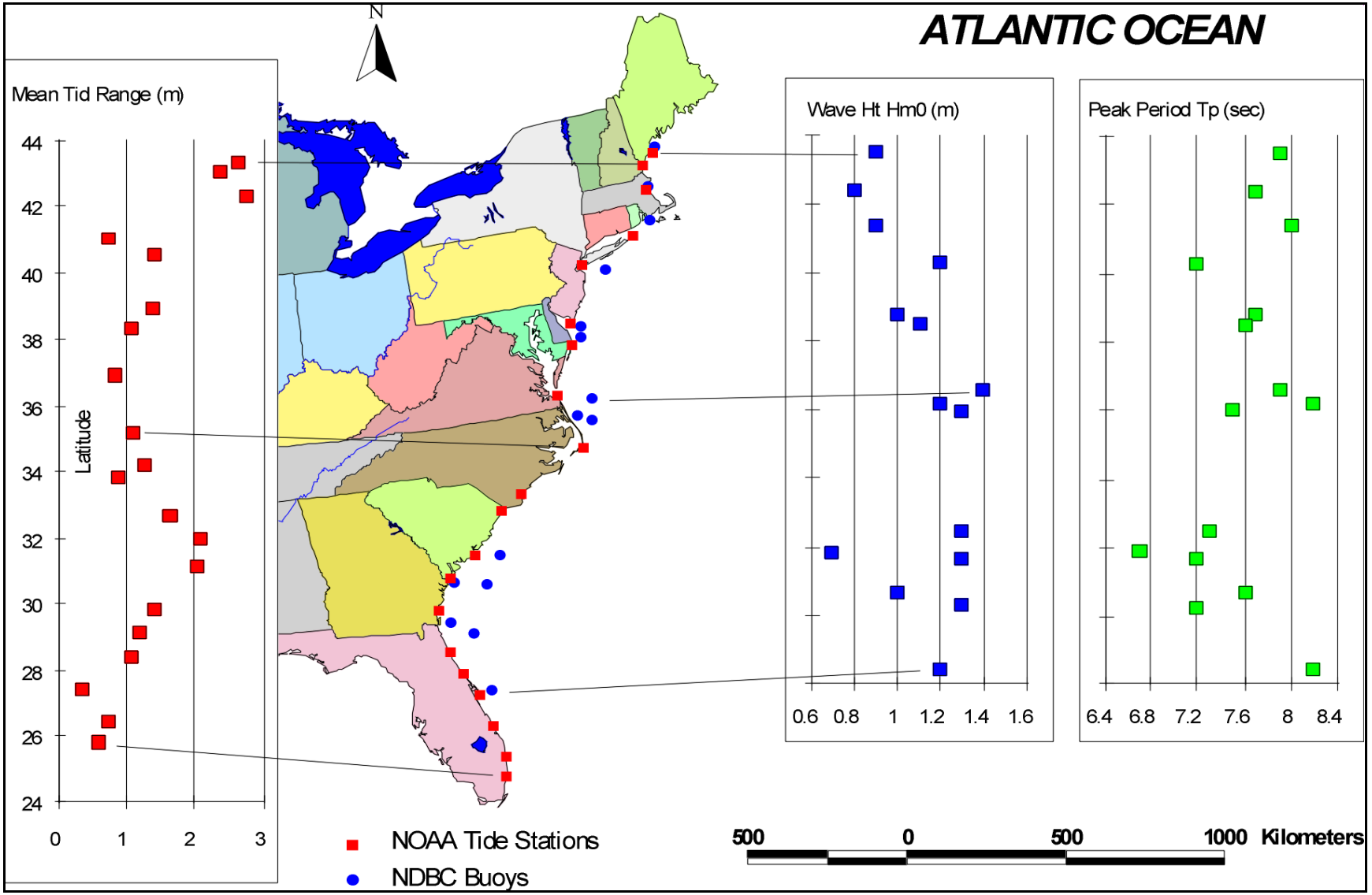

Figure I-2-2. Tide and wave characteristics of the Atlantic coasts. Wave data summarized from National Data Buoy Center buoys. H_mO and T_p averaged from hourly statistics over total period of record from statistics computed by National data Buoy Center. Tide range for indicated stations from statistics presented in NOAA Tide Tables

Figure I-2-3. Barrier Island and bay complex, southern Rhode Island. View looking west toward Quonochontaug Point, a rocky headland with bedrock outcrops. The barrier in the foreground is East Beach, with Block Island Sound to the left and Ninigret Pond to the right. Prominent overwash fans can be seen in the shallow waters of the pond (April 1977)

mark much of the coast, where sediment and marsh vegetation have partly filled the lagoons behind the barriers. Some coasts have inland ridges of old barrier islands, formed during interglacial epochs, separated from the modern barrier islands by low marshes or lagoons. The best exhibit of cuspate forelands in the world extends from the mouth of Chesapeake Bay to Cape Romain, South Carolina (Figure I-2-6). The coast is much straighter south of Cape Romain and the only cuspate foreland is that of Cape Canaveral, Florida. Barrier Islands and drowned valleys continue south to Miami, Florida (Figure I-2-7), except for a brief length of coast in the Myrtle Beach, South Carolina, area where the barriers are attached to the coastal plain. Much of the southeast coast of Florida was extensively filled, dredged, and reshaped in the early 20th century to support development (Lenček and Bosher 1998). From Miami around the tip of Florida through Alabama, Mississippi and eastern Louisiana, coastal characteristics alternate between swampy coast and white sand barriers (Shepard 1982).

c. The Atlantic and Gulf of Mexico: Coral and mangrove coasts. The barrier islands change from quartz sand south of Miami to carbonate-dominated sand, eventually transforming into coral keys and mangrove forest. The Florida Keys are remnants of coral reefs developed during a higher sea level stage of the last interglacial period. Live reefs now grow along the east and south side of the keys and the shallows of Florida Bay studded with mangrove islands extending north and west into the Everglades and the Ten Thousand Islands area that comprises the lower Florida Gulf of Mexico coast (Shepard 1982).

Figure I-2-4. New York Harbor, late 1930s. This drowned river valley system, partly sculpted by glaciers, is one of the world's finest natural harbors. The USACE has an active role dredging, clearing debris, and maintaining navigability of this great port. View looking north, with Manhattan in the center and Brooklyn to the right. Photograph from Beach Erosion Board archives